SCIENCE

NEW YORK, NOVEMBER 27, 1891.

HIGHER EDUCATION OF WOMEN.[1]

I HAVE often expressed surprise, and sometimes indignation, that citizens of a State which possesses two great universities — Columbia and Cornell — should so often decide to send their children to the universities of other States — to Harvard, or Yale, or Princeton. Apart from special preferences or personal associations with one or the other university, the parent often claims that absence from home is essential to the complete education of a boy. This proposition is, I think, open to much dispute. But it becomes still more assailable when applied to the education of girls.

It seems to me that the origin of this idea, as of so many others that claim a logical basis, is really an historical tradition, derived from conditions of life in England, where the youth to be educated were chiefly recruited from families scattered through the country, and who must therefore necessarily leave home in order to acquire a university training. In England also originated the idea that to "make a man of a boy," he must be thrown young into the often brutal public life of the great public schools, and in tender years be consigned to a rough-and-tumble existence, because in mature life this was what he would be expected to lead.

The feminine counterpart to the boys' public school was the young ladies' boarding-school. Here the girl was expected to acquire manners and finish, as there the boy was expected to learn manliness. Intellectual considerations had little to do with the choice in either case.

If we throw aside the subtle influence of tradition, and state clearly the reasons which should incline parents to send their daughters away from home to be educated, it is easier to note where these reasons may still hold in modern times and where they have become invalid.

Evidently, to share the privileges of a university, it is necessary to be a resident of a university town, so that nonresidence in such a town becomes an imperative reason in favor of sending girls away from home, if it be once decided that they are to have this training. Again, if a family is consciously and avowedly on a lower plane of intelligence, education, or refinement than that to which it is desired that the daughters shall attain, it may again be necessary to remove the latter entirely into a different sphere of life and thought, while their minds and characters are being moulded.

Or, again, it may be desired to educate girls rather against their will, as is so often the case with boys, and therefore considered best to remove them into a special atmosphere, there they shall be uninfluenced by family or social disfunctions, where, as the phrase is, "they shall have more systematic training." This might happen for younger girls, whose older sisters were going out into society.

Admitting that these considerations may all become imparative in certain cases, it remains true, however, that they must always be enforced against counter considerations of such strength as often justly lead parents to forego a college education for their girls altogether, rather than incur the risks of sending them away from home.

Whatever may be the use or abuse of a gregarious life for boys and young men, there can be no doubt that it involves great risks for adolescent girls. All the voluminous literature that has been written on the dangers of "coeducation" for girls really applies to gregarious education with members of their own sex. A girl thrown into a mass of several hundred other students, is subjected to a constant nervous strain, which, indeed, may be borne by the robust and healthy, but to which the nervous and delicate too often succumb. The physical evil of such massive association is beginning to be recognized, and combated by the device of substituting smaller groups of students in isolated homes or cottages, for the vast dormitories of the earlier colleges, which resembled magnified models of the old-fashioned boarding-schools. Still it remains true that a girl placed in an army of her fellows is in a position peculiarly foreign to her nature, which demands — possibly merely from the influence of immemorial inheritance and tradition — an individual setting, a family life. "It is natural," Goethe says somewhere, "for boys to wear uniforms: it is equally unnatural for girls to do so, for they are not destined to live or act in masses, but each is to be the centre of a home."

Thus a girl who is living at home, or who, in default of that, is living in a private family while attending lectures at a university, is running counter to no traditional organic habits of sex, whether her fellow-students be all girls, or whether the classes be mixed. But if she be removed to an institution, she is placed to that extent in the unfavorable conditions common to the monastery, the nunnery, and the orphan asylum. These unfavorable influences may, of course, be resisted, and are so in many cases, but they are always theoretically unfavorable, and not favorable, as is often claimed; and on that account certainly should not be encountered except under pressure of absolute necessity.

"The systematic training," which consists in shutting up a girl exclusively in one set of ideas, horizons, and pursuits for three or four years, is again a disadvantage and not an adyantage. The great thing that youth requires, and that female youth requires especially, is change, change of thought, scene, interest, frequent and absolute relaxation of tension. It is perfectly understood that in boys' colleges this imperative need of complete change is apt to be met, not only by innocent though boisterous recreation, but often also by far from innocent dissipation. A young man has been expected to "sow his wild oats" at college coincidently with the seed from which he hopes to reap a satisfactory harvest. But girls are too docile, too unenterprising, for these violent reactions. They have less innate force of reaction, and thus a greater tendency to adjust themselves to the exact temperature of their surroundings. It is desirable, therefore, that their surroundings should not be of a uniform character, but rather varied, accidents, such indeed as are offered by the daily incidents of family life.

The intellectual life of the university should, wherever practicable, be blended with this family life. When it is shut off from the latter, the four college years are dropped

[1] Dr. Mary Putnam-Jacobi, in the Evening Post.

like a solid isolated block into the life of the girl — we might say like a meteorite fallen from the sky. It is often felt that, when these college years are finished, everything connected with them is to come to an end, be set aside, the student herself is regarded as a finished product, turned off from a mysterious machine, to be henceforth separated from it as distinctly as a box from a turning-lathe.

All this habit of mind is again characteristically English — true English Philistinism, which is frankly indifferent to intellectual interest for its own sake — but accepts a prescribed intellectual drill as a means of attaining — it is not clearly apprehended what.

Removal of a girl from her mother's care, during the critical years of adolescence, must always be an evil morally and physically, even when it is an advantage intellectually. That is to say, it must be an evil, whenever the mother is adequate to her charge, which, of course, is only too often not the case. The girls are the exception whose health does not require constant and careful supervision, and it is absurd to expect such supervision from the girls themselves. A young person is a prig, who is competent, unadvised, to look after her own health. It is perfectly true that thousands of mothers prove themselves even more incompetent, either through indolence, or ignorance, or indifference. But, theoretically, we expect a mother to be watchful, well informed, far-sighted, and intensely solicitous. Such an anxious mother, if nervous, uneducated, and weak, may, indeed, do as much harm to the girl by over-fussing and spoiling as can the mother who is indifferent to the plainest laws of health; and the girl will do better, if removed to the impartial jurisdiction of a college faculty. But this is not then a change from good to better, but from worse to good by default.

The foregoing remarks have been suggested by surprise at the fact that relatively so few citizens of New York seem as yet to have become aware of the great advantage that has been brought to their doors by the foundation of the Barnard College for women in connection with Columbia University. Nearly half of the pupils thus far enrolled are not from New York City, but from without our gates,[1] and at the same time New York girls leave their homes every year for the colleges of other States — where they can only study under the disadvantages which have just been enumerated. Nay, more, these disadvantages are not counted as such, but on the contrary are reckoned as so many reasons for preferring the exile from home. For a quarter of a century the anomaly has existed that daughters of the wealthiest or the most highly educated citizens of the great city of New York have been deprived, except through such exile, of the educational advantages which were accessible to the inhabitants of a country town like Poughkeepsie. The parents must deprive themselves of the delight of a daughter's society during four of the most charming years of her life; or else deprive the girl of the "still air of those delightful studies" which should throw a charm over all her future life and lend a force to all her faculties. During four years all the marvellous development of thought and feeling which goes to the making of character, all the delicate details which go to the formation of manners, must proceed unwatched by the eyes that have the most intense interest in both, or else the babyish system of education must be continued, which arrests the intellectual training of a girl at the very point where, for a boy, it first begins to be strenuous. This injurious anomaly in our social structure was removed, or rather the first step was taken to remove it, when, in a measure, Columbia College opened its doors to women. Compared with what should be necessary when the girls of New York shall have come forward in proportionate numbers to claim the privileges of their university, the measure is slight and the beginning small. From this small beginning, however, a full university education for women cannot fail to grow so soon as the citizens of New York thoroughly appreciate, not only the value of such education, but the value of having its facilities at home, brought to their doors, when they realize that their girls may now claim their share in the intellectual inheritance of the race, without incurring the risks of expatriation from home which were already inherent in the boarding-schools of the sampler and crochet-needle, but are now too often laid to the account of a little Latin and less Greek.

[1] The Free Competitive Scholarship for the best entrance examination into the Freshman Class for the year 1890–91 was won by a graduate of the Jersey City High School.

CAN WE MAKE IT RAIN?[1]

THE recent experiments in rain making in Texas, under direction of General Dyrenforth, and which have attracted the attention of the whole country, seem attended by a certain amount of success.

General Dyrenforth has proceeded upon the theory that heavy concussions in the upper air currents would cause a disturbance of these currents and thus produce rain. Consequently all his attempts have been to produce the greatest possible noise in the endeavor to cause a commingling of currents proper for a condensation of their moisture.

Every scientist knows, and a moment's thought ought to convince any one, that concussions cannot cause rain-fall. An explosion in the air is immediate in its effects. It becomes in fact merely the propagation of a sound-wave, which, travelling about eleven hundred feet in a second, has but an instantaneous action upon the air through which it passes, and in which it is gradually frittered away into heat. In a small part of a second the air is again the same in temperature and density. The greatest effect, then — the practical effect — must follow close upon the concussion. Therefore, if General Dyrenforth's tremendous explosions, his "air quakes," produced rain-falls in Texas, there should have been an immediate down-pour in that particular locality as a result of each explosion. But such was not the case. In every case, according to his statements, the rain has fallen from two to twenty-four hours after the explosions, and over extended areas. In a few instances, when rain-clouds were already present, General Dyrenforth says *drops* of rain fell within a few seconds after the explosions. The violent concussions may have had to do with the formation of these drops, but the true and only valuable rain came hours after every possible effect of the concussion had gone.

It is an observed fact that rains have followed the heavy cannonading of battles. But these rains did not fall until several hours after the concussions of the air had completely ceased. So, too, the proverbial showers of the Fourth of July come late in the afternoon or during the day following.

Further, it is noticeable that during a thunder-storm lightning-flash and its attendant thunder are usually accompanied by a sudden increase of rain downpour. This has been frequently attributed to the discharge of electricity in the clouds. But the increase and the flash occur so nealy simultaneously, that the rain-drops must have started from

[1] Since the above was presented before the University Science Cl Nov. 13, I have read with interest Mr. T. G. McPherson's excellent pre tion of Aitken's experiments on "Dust," in the Popular Science Month December, 1891.

the clouds above, before the flash. Otherwise they could not have reached the earth at so nearly the same time. In fact, Professors Ayrton and Perry show (*Phil. Mag.*, 1878, v., 197) that condensation is a cause for increase of electrical potential, and this may produce the flash, and not the flash the condensation.

If, then, the lightning is the source of the sudden and increased downrush of rain, in thunder-storms the same evidence precludes the thunder also as a cause. If General Dyrenforth's heavy cannonading and concussions could evoke the rain-drops, then much more should we expect the increase with the terrific reverberations of the thunder. But all the proof is against his sound theory. The heavy detonations, then, upon which General Dyrenforth bases his theory are unnecessary, and the success of his experimenting must be looked for in causes other than the noises of the explosion.

One turns naturally, then, to the products of the explosives. In General Dyrenforth's experiments, minute solid particles of silica and carbon were liberated as results of the explosions of the dynamite and rackarock. This fine dust, entering into the upper air-layers, might have served as nuclei about which the moisture could gradually condense to finally form rain-drops. When this has been accomplished the rain fell, and not before. Even where the immense oxy-hydrogen balloons were exploded, the dynamite batteries were for hours steadily throwing fine powders of silica and carbon into the air.

Now it is well known that hail-stones, which are products of the vapor condensation, often show a nucleus of a particle of dust, and in volcanic regions frequently of a granule of ashes. In these cases a dust-particle was the centre of the condensation. This fact furnishes strong evidence to support the theory, that very small particles of dust may form the nuclei of the rain-drops and that the sudden presence of fine powder in the upper strata of air will lead to condensation if sufficient moisture be present.

It is well known that during the first few strokes of an air-pump, a vaporous cloud appears in the receiver. Some ten years ago Mr. John Aitken, in studying the London fogs, proved that if the air in the receiver be first filtered through cotton-wool so as to be dust-free, then no vapor cloud appeared (Nature, Dec. 30, 1880, 195). He came to the conclusion, and stated it clearly, that no condensation will take place unless some solid nucleus as dust be present.

The writer has recently performed some laboratory experiments similar to those of Aitken, to seek corroboration of his results, and to determine any relative difference in the properties of different dusts as regards their power for condensing moisture. I find with Aitken that condensation under the receiver of the air-pump does not take place in dust-free air, and, further, that, with different powders introduced, the amount of apparent condensation varied. The experiments were then repeated without the air-pump as follows: Into a large glass sphere filtered air was introduced, and then a steam jet discharged into it. No trace of condensation was present. Then air containing products of sulphur combustion was put in, and a heavy condensation became visible. In a similar way, vapor clouds appeared with ordinary atmospheric air and with air containing gun-powder smoke.

In this way it was found that such powders as carbon, silica, sulphur, and common salt are particularly capable of precipitating the moisture, while the burning of sulphur or gunpowder gave heavy visible clouds of vapor.

Laboratory experiments cannot represent conditions which hold on a larger scale in Nature. Still they may be suggestive. So from these experiments it may be legitimate to reason that the finest dust introduced artificially into the higher regions of the atmosphere will furnish centres for condensation, and by gradual agglomeration of moisture induce a rain-fall. It must, however, be borne in mind, that there must be sufficient water vapor in the atmosphere above to gradually collect upon the dust. Therefore not under every atmospheric condition could a rain-fall be hoped for.

To prove and to make practical use of this dust theory, elaborate and expensive experiments would not be necessary. In place of the costly outfit required by General Dyrenforth for producing his terrific noises, upon which his sound theory depends; in place of the heavy mortars transported to the plains; in place of the immense retorts with acids and chemicals for producing oxygen and hydrogen gases necessary for his balloons, there could be substituted the relatively inexpensive fire balloons. By sending up a few of these there could be carried aloft a mile or so apart a quantity of impalpable powders. Then at the heighth of about a mile any feasible means of scattering this powder into the air might furnish the occasion for an artificial rain-fall. The burning of sulphur or gun-powder by fuses timed for the proper height of the balloons should also be tried.

It might be urged against this theory, that many instances may be cited where dust has been superabundant even in the upper air layers, and no increase of rain-fall noticed; that volcanic eruptions emit quantities of finest ashes to the atmosphere above, as did Krakatoa a few years ago, whose dusty breath circled the earth for many a month, and yet no unusual aqueous precipitations were observed. But it is to be remembered that if the number of the dust particles is excessive, the amount of moisture in the air, which is always limited, will be divided among so many that the agglomeration upon each will not be sufficient to cause it to fall as rain-drops.

If this dust theory be true, the amount of powder borne aloft and exploded from the balloons need not be beyond the limits of practicable experimenting. At least the experiments necessary to test the theory would be incomparably cheaper than General Dyrenforth's, and, if successful, artificial rains could be ordered at a cost which General Dyrenforth's explosive bombardments cannot approximate.

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NOTES AND NEWS.

DR. A. H. BEALS has been appointed professor of pedagogics and natural science, Georgia Normal and Industrial College, Milledgeville, Ga.

— At the sixty-fourth meeting of German naturalists and physicians at Halle, on the 22d of September, Dr. Below gave an important address on "Health in the Tropics." He came to the conclusion that the opening up of the tropics for Europeans was practically a question of hygiene, and that, with proper sanitary precautions, the most apparently unhealthy districts may be rendered salubrious.

— At the recent meeting of the Italian Congress of Internal Medicine initial arrangements were made for the next International Medical Congress, which is to meet in Rome in 1893. In what month of the year it will be held is an important question not yet decided, according to *The Lancet*. At midsummer, or in the early autumn, Rome is not likely to be found attractive to those who dread subtropical heat in a malarious vicinity. If held in the spring, or the late autumn, many teachers of medicine will not be able to attend. The last fortnight of September is what the

majority of Italian practitioners would suggest as the most convenient time for all parties, and this will most probably be the decision of the Organizing Committee. Meanwhile, that committee has just been formed. Dr. Baccelli, at a meeting of the heads of the profession, was nominated president by acclamation. On his declining the honor, the question was put to the vote, when, out of a ballot of twenty-six, he obtained twenty-five "si," as against one "no," which was himself. He had, therefore, to bow to the overwhelming importunity of his colleagues. The post of general secretary fell, almost unanimously, to Professor Maragliano of Genoa. Presidents of the various sections were next elected. These sections are twelve in number, and, as the results of the various ballots, the following gentlemen were appointed: anatomy, Professor Antonelli; physiology, Professors Albini and Albertoni; pathology, Professors Bizzozero and Foà; pharmacology, Professor Cervello; clinical medicine, Professors Baccelli, Maragliano, Murri, and Bozzolo; surgery, Professor Bottini; obstetrics, Professor Morisani; psychiatry, Professors Morselli and Tamburini; ophthalmology, Professors Devincenzi and Secondi; dermo-syphilopathy, Professors Campana and Barduzzi; forensic medicine, Professor Tamapia; hygiene, Professors Pagliani, Celli, and Canalis. The importance attached to this great medical parliament is already apparent in the number of physicians and surgeons who have intimated their intention to assist.

— The Volcano Islands have been annexed by Japan. The group lies 135 miles to the south-east (south-west?) of the Bonins and about 1,700 miles from Yokohama. It consists of Sulphur Island, situated in 24° 46′ north latitude, and 141° 19′ east longitude; St. Alexander, 40 miles to the north of Sulphur Island; and St. August, at the same distance to the south. The area of the middle island, which is the largest of the three, is only five square miles. The only natural product of any importance is sulphur, which is found in a very pure state ready for shipment. The natives of the Bonins also visit these islands for the sake of the fishing.

— An extended tour of a representative of Tiffany & Co., New York, during the past summer, through Ireland, England, France, Germany, Austro Hungary, Bohemia, Russia in Europe, and Asia, where he visited all the cutting centres where stones are mined, the collections and museums, enables them to show a finer collection of gems, precious and semi-precious stones, and art objects in stone, jade, crystal, etc., than has ever been brought together at one time in this country. Notable, from the Ural Mountains, is a collection of Alexandrites, topazes of blue, green, and sherry colors, demantoids or green garnets, royal purple amethysts, changing color by artificial light, the finest and largest that have been seen in modern times; from the Ural gold washings, sapphires; pale, yellow, and blue rubies; beryls of golden yellow and green, of which two are the finest that have come from Russia in the last decade; and lapidary work peculiar to the Urals, in rock crystal, garnet, amethyst, topaz, sard, jade, and rhodonite; from the Hungarian opal mines, the finest specimen of noble opal that has been obtained for many years; from France, lapidary work equal to that famous in the periods of Louis XIV., XV., and XVI.; from Italy, Bosnia, Greece, Bactria, Assyria, and Egypt, antique intagli, stone scarabie and cylinders, incised sard cornelian, chalcedony, plasma, sardonyx, essonite, hematite, etc., some dating as early as the fifth century B.C.; from Ireland, Mourne Mountain, deep blue aqua-marines, and one very fine amethyst.

— A bulletin has been issued by the Bureau of Education, Washington, for the purpose of giving information respecting the appointment of a chief of the Department of Liberal Arts, known as Department L, and respecting the organization for holding educational congresses in connection with the World's Columbian Exposition of 1893. Since Bulletin No. 3 was issued Dr. Selim H. Peabody of Illinois has been appointed chief of the Department of Liberal Arts. Dr. Peabody was for many years the president of the University of Illinois, at Champaign, Ill. The World's Congress Auxiliary of the World's Columbian Exposition is a body authorized and supported by the exposition. It has been organized to provide for the holding of such congresses in connection with the Columbian Exposition in 1893 as will best show the intellectual and moral progress of the world. The intention is to provide proper committees to secure the attendance of leaders in all branches of human knowledge, to provide convenient meeting places, to arrange and superintend the meetings, and to publish the proceedings of all the congresses. The organization is composed in the first place of two branches, the men's and the women's, and each of these is again subdivided into two classes, resident and non-resident. The resident class of each branch is the part from which the members of committees are to be chosen. Certain non-resident persons who may be especially invited to co-operate with local committees are to be made members of advisory councils of departments, divisions, chapters, or sections, and they are expected to aid the local committees by corresponding freely and by personal conference as opportunity may offer. Other eminent non-resident persons are to be known as general, honorary, and corresponding members of the auxiliary. The general officers of the auxiliary are Charles C. Bonney, president; Thomas B. Bryan, vice-president; Lyman J. Gage, treasurer; and Benjamin Butterworth, secretary. The address is Rand Building, Chicago, Ill. Congresses are proposed for each one of the six months that the exposition is to be open. Those proposed for July are science, philosophy, invention, and education, including congresses of colleges, universities, teachers, superintendents of schools, astronomers, archæologists, botanists, chemists, electricians, geologists, ethnologists, geographers, mineralogists, metallurgists, zoologists, etc. The arrangement for the educational congress has been entrusted to a committee appointed for the purpose by the National Educational Association. Now that a chief of the Department of Liberal Arts has been appointed, the Commissioner of Education calls the attention of all educational exhibitors to the fact that the Bureau of Education has a position quite similar to their own, and can not be expected to give any information regarding the plans and scope of the educational exhibit, excepting in so far as it may be requested to do so by Dr. Peabody. All such information should be obtained directly from Dr. Selim H. Peabody, whose address is Rand Building, Chicago. The Commissioner of Education is desirous of aiding in the preparation of this work in any way that does not conflict with the authority of the regularly appointed officers of the World's Columbian Exposition.

— The King of the Belgians has offered a prize of 25,000 francs (£1,000) to be awarded in 1897 for the work giving the most satisfactory replies to the following questions: Describe, from the sanitary point of view, the meteorological, hydrological, and geological conditions of the territories of Equatorial Africa. Deduce from the present state of our knowledge concerning these matters the hygienic principles suitable for these regions, and lay down, with observations in support of the conclusions arrived at, the best scheme of life, diet, and work, as well as the system of clothing and form of dwelling best adapted for the preservation of health and vigor. Describe the symptomatology, etiology, and pathology of the diseases which characterize the regions of equatorial Africa, and indicate the treatment, both prophylactic and therapeutic. Define the principles to be followed in the choice and use of medicaments and in the establishment of hospitals and sanatoria. In their scientific researches, as well as in their practical conclusions, competitors should particularly take into account the conditions of existence of Europeans in the different parts of the Congo basin. The prize is open to foreigners as well as to Belgian subjects. Competitors must send in their works to the Minister of the Interior and of Public Instruction at Brussels before Jan. 1, 1897.

— The World's Fair Archæological survey, under the field assistants, Warren K. Moorehead and Dr. H. G. Cresson, located at Anderson Station, Ross County, Ohio, made a remarkable discovery upon Mr. C. Hopewell's farm, Nov. 14. The tumulus examined is 500 feet long, 200 feet wide, and 28 feet high. It lies in the centre of a group of twenty-six mounds, all of which were opened in September and October with good results. On account of its great size the mound was divided into five sections of forty feet each for convenience in excavating. In the first cut made i

the east end nothing was found. Near the surface of the second cut two bowlder outlines resembling panthers were uncovered and measured. Like the effigy mounds in Wisconsin, they were 85 to 90 feet long, being composed of one thickness of stone. The heads, limbs, and tails were distinctly outlined. Near the bottom of the second cut were three skeletons, with objects of copper, bone, and shell. North of this deposit lay the great medicine man, or chief of the village which had erected the mound. If the number of implements is evidence of the esteem in which a prehistoric man was held by his people, he was certainly the most important Caique of the Scioto Valley. At his head were imitation elk-horns, neatly made of wood and covered with sheet copper, rolled into cylindrical form over the prongs. The antlers were twenty-two inches high and nineteen inches broad at the top. They fitted into a crown of copper, bent to fit the head from occipital to upper jaw. Copper plates were upon the breast and stomach; also on the back. The copper preserved the bones and a few of the sinews. It also preserved traces of cloth similar to coffee sacking in texture, interwoven among the threads of which were nine hundred beautiful pearl beads, bear teeth split and cut, hundreds of other beads of both pearl and shell. Copper spool-shaped objects and other implements covered the remains. A pipe of granite and a spear-head of agate were near the right shoulder. The pipe was of very fine workmanship, and highly polished. The mound is still in process of examination, two months being yet required to open it thoroughly. It is thought to indicate connection with the Aztec people, as such head-dresses are only found in Mexico and Yucatan.

— Since Laveran discovered a parasite in the blood of several patients suffering from malarial fever ten or twelve years ago, many other observations on this interesting subject have been made both by himself and by many other writers, Continental, American, and Indian. One of the latest papers on the subject is a dissertation by Dr. Romanovski of St. Petersburg, reported in *The Lancet*. He thinks that the malarial parasites are so inseparably associated with the disease that the blood of patients supposed to be suffering from malaria ought to be examined as a matter of routine, as the sputum of phthisical patients is, for microbes. He finds that the amœboid parasite of tertian fever has a nucleus which acts by means of a fibrous metamorphosis of the chromatin net-work, and not by a direct method. When quinine is administered in sufficient doses it causes the destruction of the amœboid parasite, the degeneration, which is easily observed, chiefly affecting the nucleus. With regard to the prescription of quinine, he says that it should be given in two doses of about fifteen grains each during the twelve hours immediately preceding the attack, because during that period the number of adult parasites is at its maximum. From some observations made with tincture of sunflower Dr. Romanovski was led to the conclusion that this drug, though not without its influence on malarial fever, cannot be considered as a satisfactory substitute for quinine. He appends to his work references to more than 120 articles bearing on the subject, some few of which are in Russian, but the great bulk are in more accessible languages.

— The fame of the Cape as a health resort is not of recent growth, says *The Lancet*. In the old days of our Indian Empire, long before the Suez Canal was projected, and when connection with the East was maintained exclusively by sailing ships around the Cape of Good Hope, Cape Colony was the favorite recruiting ground for our countrymen exhausted by the toils or climate of Hindustan. The Suez Canal and steam have altered all this, and the Cape has suffered in consequence. It is once more becoming known as a health resort, in consequence of that widespread movement of travel which is now making all parts of the world familiar, and turning their special features to advantage not only for commerce and adventure, but for health. The broad features of the Cape climate are as follows. Great dryness, clearness, and rarefaction of the atmosphere; abundance of sunlight; considerable maxima of heat, which are nevertheless free from depressing effects and consistent with vigor and activity; cool nights, a considerable proportion of wind; a long summer and winter, with a correspondingly short spring and autumn; much dryness of soil and scantiness of forest and vegetation. The health record is, on the whole, good. There is no yellow fever or cholera. Pulmonary affections are alleged to be relatively somewhat infrequent. Hydatids, so frequent in Australia, are rare. Rheumatism and neuralgia are frequent. Speaking generally, accommodation and means of communication are bad, but appear to be undergoing a steady change for the better.

— The *Lancet*, in describing a military bicycling trip in which the party made one hundred miles in about ten hours, says in conclusion: The most interesting part of the narrative has still to be told. The veteran cyclist, Major Knox Holmes, at the near close of his eighty-third year, mounted on a tandem with Mr. Males, a young rider under eighteen years of age, accompanied the corps, and arrived at the termination of the expedition five minutes in advance of the rest. He was a little distressed on dismounting, from too hard riding the last few miles, but he soon threw off his fatigue and joined his companions at dinner with thorough zest. His condition is physiologically peculiar. In twelve weeks' new training he has, in the most striking manner, "developed muscle" in the external and the internal vasti, the rectus, and the muscles which form the calf of the leg. It has become so entirely a part of physiological doctrine that after threescore years and ten there is no new development of muscle, that if we had not seen with our own eyes, as we have, this actual development in one whose age exceeds by thirteen years the traditional span of human life, we should have doubted the possibility of its occurrence.

— An official report by Mr. Hughes of the Geological Survey of India, on tin-mining in the Mergui district of Burmah, contains a description by Mr. Adam of a remarkable tin deposit discovered in the Maliwun district. After tracing a reef which attracted his attention from hill to hill, and taking specimens in various places and in a variety of ways, these gave such extraordinary results "that I felt myself quite puzzled to account for the enormous masses of wealth lying unheeded, more especially as many years before a European company lost all its capital within a short distance of this very place. . . . It is a most extraordinary deposit, quite beyond anything I have ever seen in my travels, nor have I heard of any miner or prospector meeting anything so rich." He then details two experiments, by one of which he got 141 pounds of ore from two cubic yards of the most unlikely rock he could see, and by the other 141 pounds of ore from one cubic yard of unselected rock. "These results," he says, "multiplied by the enormous masses of these hills, would give figures altogether fabulous in their dimensions." Mr. Hughes is not quite so enthusiastic about the discovery. He says: "I twice visited this reef, once in company with Mr. Adam and again with Dr. King, the director of our survey. There is nothing I would term a main lode, but rather a zone of metamorphic rocks through which runs of varying ore-bearing quartzes can be traced. Many of the smaller seams, of a reddish-brown color, are heavily weighted with tin ore, giving as high a proportion as 60 per cent, The primary value of the reef is dependent on the persistence of these courses of quartz; for, apart from them, little or no ore was obtainable by rough washing samples of the rock. In dealing with the claim of this reef to exceptional richness, we have to allow for the vicissitudes which seem to dog the persistance of all metalliferous indications in India, and we have to allow for the accident of the courses of quartz dying away as they descend. At first sight there is nothing to suggest such a liability, but we have, in the history of unsuccessful efforts to work the lodes from 1873 to 1877, a warning as to the possibly fleeting nature of the deposit under discussion. This, however, is the very worst aspect that can be assumed. And the pleas on the other side are that the reef has been traced for more than three miles, that a large portion of it can be won by surface blasting, and that the statements made as to the precarious character of the runs of quartz are based on imperfect evidence. The point on which there can be no dispute is that there is a large mineralized zone of rock exposed in the form of a prominent, well-defined hill, which is free from any speculative doubts as to its existence. At the spot known as Khow Muang there are at least 60,000 tons of reef within sight."

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Attention is called to the "Wants" column. All are invited to use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

JOHN FRANCIS WILLIAMS.

JOHN FRANCIS WILLIAMS, Ph.D., assistant professor of geology and mineralogy in Cornell University, died at Ithaca Monday evening, Nov. 9, 1891. Although Dr. Williams was only twenty-nine years of age, he had achieved eminent distinction. He took his baccalaureate degree at the Troy Polytechnic Institute, and afterward studied at Göttingen for three years with such success that when his professor, Dr. Klein, went to Berlin, Dr. Williams accompanied him as assistant. Returning to America, he was appointed curator of the mineralogical and industrial collection of the Pratt Institute of Brooklyn, L.I., which, conjointly with Professor Nason of the Rensselaer Polytechnic Institute of Troy, was formed in Europe. He then became docent in Clark University, and afterwards was employed in a very important part of the State survey of Arkansas. In the course of the survey, extending over two years, he collected minerals for a very complete report on the mineralogy and petrography of the State, a volume of some four hundred pages being now in press. Some of his work has been complimented by Dr. Rosenbusch, the greatest living authority, as among the best he had ever seen done by an American.

Dr. Williams had just entered on his work of instruction in Cornell, when it became apparent that he had brought from the malarious regions of Arkansas the seeds of a fatal disease. His instruction was highly praised by his students, and he was universally esteemed by his colleagues.

Dr. Williams was one of the best of the new school of mineralogists, being thoroughly rounded in his knowledge of the science, being an excellent chemist, crystallographer, petrologist, and geologist.

Dr. Williams was born at the old family homestead, in Salem, N.Y. He was the son of John N. Williams, and belonged to one of the oldest families in New York.

Among his published papers were "Eudialyte and Eucolite, from Magnet Cove, Arkansas," in *American Journal of Science*, December, 1890; "Manganopectolite from Magnet Cove," Zeitschrift f. Krystallographie und Mineralogie, P. Groth, Leipzig, November, 1890, pp. 386–389; "Igneous Rocks of Arkansas," Vol. II. of the Publications of the Survey, 1890; "Ueber den Monte Amiata in Toscana und Seine Gesteine" [Mit. Taf., XII.–XVI.]. Neues Jahrbuch für Mineralogie, Geologie und Paleontologie, BB. V. 381, 1886, his most important work; and a volume of some four hundred pages on the mineralogy and petrology of Arkansas, now in press.

THE COMMON EDIBLE CRAB FOUND FOSSIL IN THE HUDSON RIVER TUNNEL.

DURING work on the Hudson River tunnel, as carried on from the New Jersey side, and when at a distance of about 3,100 feet from the New Jersey opening, one of the workmen noticed a hard nodule among the silt as it was being taken out at the heading, and secured it as an object of curiosity. On being washed the nodule, which is about six and a half inches long by two and a half wide and an inch thick, was seen to contain quantities of a small sea shell (*Mactra lateralis* say) and remains of a crab.

Subsequently this nodule, which is of a hard limestone nature on the inside, although soft and muddy externally, came into the possession of William Dutcher, Esq., of this city, who presented it to the American Museum of Natural History, where it will be preserved in section 12 of case Q of the Geological Hall.

On removing some of the stone from the left side of the back, the lateral spine characteristic of our common blue or edible crab (*Cullinectes hastatus*, Fabricus; = *Lupa dicantha*, Latreille, of the New York State Natural History, Zoology, plate III., fig. 3) is shown, which proves it to be an ancient example, about two-thirds grown, of this much esteemed and highly prized frequenter of our city markets, restaurants, and hotels, as well as of many private tables, although at present by no means in the soft shell condition, for the nodule is so hard internally as to yield only to the action of a hammer and chisel; although externally looking like a nodule of hardened mud. The nodule exposes a little more than half of the upper surface of the back, and parts of each of the large claws; and in removing the stone from the surface, impressions of several leaves were exposed, and a fragment of sea grass.

The finding of this species in a fossilized condition, in the position from which it was taken, is a matter of considerable interest, as it is the only instance known of its existence in a fossil condition. It proves this animal to have inhabited the shoals and bays of this region for a period dating back to probably long before the advent of man, for its depth below the bottom of the river at that point, which is about thirty-five to forty feet to the centre of the tunnel, together with its perfectly fossilized condition, would indicate the lapse of considerable time since its entombment.

R. P. W.

ASTRONOMICAL NOTES.

ON May 22, 1886, Mr. W. R. Brooks, then living at Phelps, N.Y., discovered a telescopic comet which has been the subject of an extensive discussion by Dr. S. Oppenheim of Ottakring. He finds that the comet is a short-period one, of from 5.7 to 6.1 years. In No. 3,064 of the *Astronomische Nachrichten* Dr. Oppenheim publishes a sweeping ephemeris covering the period from Jan. 1 to Sept. 17, 1892.

Previous to his death, Professor Theo. Oppalzer had under his charge the orbit of the short-period comet discovered by

Professor Winnecke, at Bonn, on March 8, 1858. This comet was originally discovered by Pons, at Marseilles, on June 12, 1819. Since Oppalzer's death, Dr. Haerdtl of Vienna has taken up the orbit and discussed it, and also computed the perturbations the comet has experienced since last seen. The last return of the comet was in 1886, when it was discovered by Mr. Findlay, at the Cape of Good Hope, Aug. 20. At the time of discovery the comet had passed its perihelion, and was twelve days ahead of its predicted place. Its distance from the earth at the time of discovery was about one hundred and fifty million miles. In No. 3,062 of the *Astronomische Nachrichten* Dr. Haerdtl publishes an ephemeris to assist in finding the comet during its approaching return. The date of next perihelion passage is June 30, 1892. At the present time the comet is about two hundred and fifty millions of miles from the earth, and is of course beyond the reach of all but the most powerful telescopes, and probably even them. In the latter part of next January the comet should be within the reach of moderate-sized telescopes. A copy of the ephemeris will be published before that date.

The following are the positions for Wolf's comet for following dates. The epoch is for Greenwich midnight.

1891.	R. A.			Dec.	
	h.	m.	s.	°	′
Dec. 1.5	4	24	18	—13	22
3 5		23	4	13	43
5.5		21	52	14	0
7.5		20	45	14	15
9.5	4	19	42	—14	27

The eclipse of the moon on the night of the fifteenth of the present month was not generally observed at stations in the eastern portion of the United States, due to a very cloudy sky. The only satisfactory observations, as far as known, were those made at Harvard Observatory. It was cloudy at Albany, Rochester, Princeton, Washington, and the University of Virginia, points at which large telescopes are located. Professor Dölland, late of the observatory at Pulkova, Russia, had prepared a large list of stars that would be occulted during the eclipse. Preparation had been made at the several observatories mentioned to observe as many of these stars as possible, to assist in revising the present value of the semi-diameter of the moon.

FOREST AND MINERAL WEALTH OF BRAZIL.

A BULLETIN lately issued by the Bureau of the American Republics states that the inexhaustible forests of Brazil abound in woods of great value, some of the most beautiful and valuable being entirely unknown in Europe. The large collection of Brazilian woods exhibited in Philadelphia in 1876 attracted much attention, and the catalogue mentions 22,000 different woods found in the valley of the Amazon alone. The best known of the valuable woods among those of the Amazon are rosewood, satin wood, shell wood — of which latter beautiful shell-like articles are made. The cedars of Brazil are entirely different from the European, and they abound everywhere from north to south. During the floods of the Amazon, they are seen borne along by the current, as a writer on Brazil describes them, "mighty trunks of foliage like floating islands." Among the medicinal plants of the Amazon valley may be mentioned the sarsaparilla, ipecacuanha, the polycarp, the cubeb, the curare,— from which the Indians extract the poison for their arrows, — the *nux vomica*, etc. On the Atlantic coast, the variety of valuable woods is continued, and mention may be made of the acapú and angelica, and the bacury, which is the building wood most in use in Maranham.

The forests abound in plants producing textile fibres. A firm at Ceará has lately commenced the manufacture of the *gravatá* fibre, a plant belonging to the *bromeliacea*. The rubber tree exists in several varieties, producing as many different sorts of rubber, and all through the northern regions it thrives well. The once famous Brazil wood, which gave its name to the country, lost its importance with the discovery of the cheaper aniline dyes, and its exportation has dwindled to insignificance. Gutta-percha is produced in Brazil from two species of trees, the jaguá (*Lucuma gigantea*) and the massaranduba (*Mimusops elata*). The beautiful vinhatico, much employed in Brazil for furniture and cabinet work, enjoys a considerable reputation, the greater part of the furniture in Brazil being made either of rosewood or vinhatico. The beautiful shaded yellow of this latter makes it remarkable among the woods at once useful and ornamental.

The development of the vast mineral resources of Brazil, with the exception of gold and diamonds, has only just begun. Its deposits of coal and iron, laid bare by scientific explorers, await for the most part the labor and machinery necessary to utilize them. The existence in Brazil has been demonstrated of copper, manganese, and argentiferous lead ore, in considerable quantities, and in widely extended localities. There are also mines of iron, coal, gold, and diamonds. Gold is found in every State in Brazil, and is systematically mined in Minas Geraes, Rio Grande do Sul, Bahia, Matto Grosso, Parana, Sao Paulo, and Maranham.

Diamonds are co-extensive with the gold-deposits, and, like that metal, are most abundant in Minas Geraes, where they have been found since 1789. The most important locality known for the production of these gems is the district of Diamantina, in the above-named State. They are found in Parana, in the gravels of the river Tibagy, and in the bed of streams dry during the summer. Since the discovery of diamonds at the Cape of Good Hope, the Brazilian production has greatly diminished.

As regards iron, the State of Minas Geraes abounds with it. It is not found in veins or strata, buried deep in the earth, but in enormous beds, often lying at the surface, or in mountain masses. These vast deposits are worked only by small scattered furnaces, charcoal being used in the reduction of the ore. Of these small furnaces there are five groups, producing about 3,000 tons annually, the product being used in the surrounding districts in the manufacture of articles of home consumption, such as hoes, shovels, picks, drills, nails, horseshoes, etc. In the State of San Paulo are found deposits similar to the best Norwegian ore; and one of the mines is worked by the Government establishment, near the village of Sorocaba. This establishment has two furnaces, and produced in one year about 790 tons of pig iron. The ore has about 67 per cent of iron. In Santa Caterina, not far from a harbor accessible to the largest vessels, are vast deposits of hematite, containing on an average 30 per cent of manganese, and 25 to 30 per cent of iron. In the State of Goyaz, as in Minas Geraes, are found enormous masses of the ore itaberite.

The presence of copper has been demonstrated in Rio Grande do Sul, in Matto Grosso, in Minas Geraes, and Ceará. The ore has never yet been mined, but in the last named State works have been begun with a view to its extraction and reduction. The ore, as far as yet reached, yields 40 per

cent of copper. The deposits of lead so far discovered are few, but its presence has been determined in Rio Grande do Sul, Sao Paulo, and Minas Geraes, generally in connection with silver — argentiferous galena — and sometimes with gold. Bismuth and antimony are found in combination with ores of other metals, but not as yet in considerable quantities.

Up to the present, the deposits of coal discovered are not, relatively, so extensive as those of iron, but its presence has been determined in Sao Paulo where the borings indicated its existence in quantities and situations that render probable a profitable extraction. In Santa Caterina, in the valley of the Tubarao, bituminous coal exists, and a concession has been granted by the Government for working the beds. The State of Rio Grande do Sul appears to be the most favored in respect to coal deposits. In the Candiota basin, veins of coal crop out, of a thickness varying from four to six feet, but the only mines worked up to the present are those of Arrois dos Ratos, which supply coal to the steamers that ply on the river and to the Government railway.

Marbles are abundant and widely distributed; they are of various colors, and resist the disintegrating influences of the climate, under conditions destructive of the marble imported from Europe. In Rio Grande do Sul and Sao Paulo are various manufactures of works of marble. Important deposits of loadstone are found in Minas Geraes. In the State of Goyaz, in the Sierra dos Cristaes (Crystal Range) are found in abundance the well-known "Brazilian pebbles," whose pure quartz is employed in the manufacture of lenses and spectacles. They are found near the surface, usually covered with a coating of iron oxide. In the calcareous caverns of the San Francisco plateau and of the river Velhas, in Minas Geraes, saltpetre has for a long time been collected. One of these grottoes, near Diamantina, furnished within a few days after its discovery forty tons of the pure crystals. Graphite is also found in considerable quantities in Minas Geraes, one of the deposits yielding 83 per cent of carbon suitable for pencils.

THE CLIMATOLOGY OF BRAZIL.

A PAMPHLET by Sr. H. Morize, entitled "Esboço de uma Climatologia do Brazil," has been issued from the Observatory of Rio Janeiro. The author divides the country into three great zones — tropical, subtropical, and temperate. The first, in which the mean temperature exceeds 77° F., embraces the northern part of Brazil, and is bounded to the south by a line running along the south side of the State of Pernambuco, across Goyaz, and somewhat to the south of Cuyabá. The second lies between the isothermals of 77° and 68°, and extends into S. Paulo and Paraná, leaving a portion of these provinces, with Sta. Catharina and Rio Grande do Sul, to form the third zone, in which the mean temperature oscillates between 68° and 59°.

The tropical zone may be again divided into three regions, the Upper Amazons, Matto Grosso and the interior of the states on the Atlantic border, and the Littoral. On the Upper Amazons there are two rainy seasons, the principal one lasting from the end of February to June, and the other from the middle of October to the beginning of January. During the intervening dry season the rivers fall sometimes as much as 46 feet. Sr. J. Pinkas found that the mean temperature was 79°, but the maximum was 103°, which is comparatively low. The heat, however, was very oppressive, owing to the excessive moisture in the air. The prevailing wind blows from the south-west, and is frequently interrupted by calms. Towards the end of the great rains the phenomenon known as *friagem* occurs, which is a sudden fall of temperature produced by an influx of cold air from the Andes. It can only take place on a calm day, and is preceded by a high temperature, an almost complete saturation of the air, and a barometric fall of about .2 inches.

In the second subdivision heavy rains occur in spring and summer, and the thermometer often rises as much as 35° in a few hours. These sudden changes are produced by the rapid alternations of north-west and south-east winds, the former warm and moist, the latter always very cold. Dr. Morsback gives the mean temperature as 79.25° F. The average rainfall is 45.9 inches, and the number of raining days 85. In this region also there is a period of *friagem*.

The third subdivision is characterized by rains in summer and autumn, and particularly during the month of April. The differences of temperature are much less than in the other subdivisions, 84° F. having been recorded at Vizeu in Pará during December, the warmest month, and 80° F. at the same hour, 9 A.M., during July, the coolest month. The mean rain-fall is about 58 inches. In the dry season the prairies are withered and scorched by the heat, and the cattle that feed on them suffer terribly. Occasionally the rains do not make their appearance at all, and then famine spreads throughout the country. This calamity has occurred six times already during the present century.

The subtropical zone closely resembles the warm regions of the south of Europe. Both the temperature and the rainfall vary considerably according to the situation. The climate of the third zone is one of the finest in the world, and therefore the States comprised in it have been almost exclusively chosen by European immigrants. The rainy season does not occur in the same months as in the other regions: rain falls chiefly in the winter and autumn. As the distance from the equator increases, the transition between the wet and dry seasons becomes less distinct. The meteorology of Sao Paulo and Rio Grande do Sul has already been noticed in the *Scottish Meteorological Journal* (vol vi., p. 332, and vol. vii., 556). Sr. Morize's paper is very useful for those who wish to study the subject minutely, for he has collected numerous records of observations from all parts of the country.

YEZO.

THE island of Yezo, or Hokkaido, has an area of about 30,500 square miles. Its population, said to have been 27,000 in 1869, was, in 1889, 254,805 (including the Kurile Islands), according to the Japanese census reports. The Government, according to the *Scottish Geographical Magazine*, is actively developing the country. It is constructing a net-work of roads by convict labor, and intends to form a new capital near the source of the river Ishikari. The plan provides for 17,472 colonists, besides 1,920 houses for Tonden-he. These latter are military colonists, each of whom receives a grant of about 8 acres of land and a house, on condition of serving in war up to the age of 40. Another town is to be founded on the Sarachi. A railway from Sapporo to Mororan has been proposed, the harbor at this place being more convenient than that of Orunai, where the coal of Yezo is now shipped. The dwellings of the inhabitants are by no means adapted to the rigor of the climate: those of the military colonists are slightly superior, and consist of two apartments. Cultivation and fishing are the chief occupations. Vegetables, millet, potatoes, wheat, barley, rice, and beet-root are culti-

vated — the last for the making of sugar. Cattle, pigs, and other domestic animals are kept in small numbers, but little attention is bestowed upon them. The Government has set up mills and sugar and hemp factories. At present they have not been remarkably active, owing either to the deficiency of raw material, or to the absence of a demand for the finished article. Fishing is a far more important industry. The annual value of the products of the sea is about £833,000, and it is on them exclusively that the taxes are levied. Herrings, salmon, and trout are extraordinarily plentiful on the northern and western coasts of the island, and cod is caught in the deep water. The native fishermen number about 60,000, and in the season these are reinforced by hired men from the island of Nipon. There are in the whole island about 17,000 Ainos, but their number is decreasing owing to the effects of disease and, more than all, intermarriage with the Japanese. In the north-east they are still in a state of degradation, but along the shores of Volcano Bay they are beginning to occupy themselves in agriculture. They are well treated by the Government, and enjoy the same rights as Japanese. Where it is possible, their children attend the Japanese schools.

PROFESSOR PICTET'S LABORATORY AT BERLIN.[1]

IT has often been remarked that purely scientific research frequently bears fruit of practical value. A fresh illustration of this fact is afforded by the work of Professor Pictet, the eminent man of science of Geneva, who is turning to practical account the apparatus by which, in 1877, he first reduced hydrogen and oxygen to the liquid state. At Berlin, where he now resides, he has established, on the scale of a small factory, what he terms a "laboratoire à basses températures." The following account of the work carried on and the results obtained is taken from papers read by the professor before different scientific societies of Berlin.

The refrigerating machinery, driven by several powerful steam-engines, is intended to withdraw heat from the objects under observation, and to keep them at any temperature between —20° and —200° C. as long as may be required. Professor Pictet's experience has led him to the conclusion that among the refrigerating agents known, such as rarefaction of gases, dissolution of salts, evaporation of liquids, the latter is to be preferred. A long course of research has further enabled him to choose the most convenient from amongst the great number of suitable liquids. In order to avoid the great pressure required in handling the highly evaporative substances of lowest boiling-point which serve to produce extreme cold, it is necessary to divide the difference of temperature into several stages. Each stage is fitted with especial apparatus consisting of an air-pump worked by steam, which drains off the vapors of the liquid from the refrigerator, and forces them into a condenser, whence, reduced to the liquid state, they are again offered for evaporation in the refrigerator. Thus the liquid, without any loss beyond leakage, passes through a continuous circuit, and the operations can be carried on for any length of time. The liquid made use of for the first stage is the mixture of sulphurous acid and a small percentage of carbonic acid called "liquide Pictet." It is condensed at a pressure of about two atmospheres in a spiral tube merely cooled by running water. Oxide of nitrogen (laughing gas) is the liquid chosen for the second stage. Its vapors are condensed in the same way at a pressure about five or six times as great in a tube maintained at about —80° by the action of the first circuit. As medium for a third stage, in which, however, continuous circulation has not yet been attempted, atmospheric air is employed, which passes into the liquid state at a pressure of no more than about 75 atmospheres, provided the condenser is kept at —135° by the first two circuits. The evaporation of the liquefied air causes the thermometer to fall below —200°.

By this combination quite new conditions for investigating the properties of matter are realized. In various branches of science new and surprising facts have already been brought to light. Many laws and observations will have to be re-examined and altered with regard to changes at an extremely low temperature.

For instance, a remarkable difference was noted in the radiation of heat. Material considered a non-conductor of heat does not appear to affect much the passage of heat into a body cooled down to below —100°. Or, to state the fact according to Professor Pictet's view: "The slow oscillations of matter, which constitute the lowest degrees of heat, pass more readily through the obstruction of a so-called non-conductor than those corresponding to a higher temperature, just as the less intense undulations of the red light are better able to penetrate clouds of dust or vapor than those of the blue." If the natural rise of temperature in the refrigerator, starting from —135°, is noted in a tracing, and afterwards the same refrigerator carefully packed in a covering of cotton-wool of more than half a yard in thickness, and cooled down afresh, and the rise of temperature again marked, on comparing the tracings hardly any difference will be found in the two curves up to —100°, and only a very slight deviation even up to —50°. On this ground it is clear that the utmost limit of cold that can possibly be attained is not much lower than that reached in the famous experiment of liquefaction of hydrogen. The quantity of warmth which hourly floods a cylinder 1,250 millimetres high by 210 millimetres wide (the size of the refrigerator) at —80°, is no less than 600 calories, and no packing will keep it out. At a lower temperature, the radiation being even greater, the power of the machinery intended to draw off still more heat would have to be enormous. And as —273° is absolute zero, the utmost Professor Pictet judges to be attainable is about —255°.

As an example of the surprising methods which the refrigerating machine permits the investigator to employ, it may be mentioned that, in order to measure the elasticity of mercury, Professor Paalzow had the metal cast into the shape of a tuning-fork, and frozen hard enough for the purpose in view. On this occasion it appeared that quicksilver can be shown in a crystallized state, the crystals being of a beautiful fern-like appearance.

Glycerine was likewise made to crystallize; and cognac, after having been frozen, was found to possess that peculiar mellowness commonly only attained by long keeping.

But the most important application of the refrigerating machinery has been the purification of chloroform, undertaken by Professor Pictet, at the instance of Professor Liebreich of the Pharmacological Institute, Berlin. Chloroform has hitherto been considered a most unstable and easily defiled substance. The action of sunlight, the slight impurities retained from the different processes of manufacture, perhaps the mere settling down during protracted storage, have invariably resulted in a more or less marked decomposition. By the simple process of crystallization this unstableness is got rid of, and a practically unchangeable liquid is produced. The crystals begin to form at —68°, first covering the bottom of the vessel, and gradually filling it up to

[1] From Nature.

within one-fifth of the whole volume. This residue being drained off, the frozen part is allowed to melt under cover, so as to exclude the atmospheric moisture. Chloroform thus refined has, by way of testing its durability, remained exposed on the roof in a light brown bottle from November till June without the slightest sign of decomposition.

Professor Pictet has already taken steps to introduce his process into manufacture, and proposes to apply the principle to various other chemical and technical objects. Sulphurous ether, for instance, has by a similar process been produced in a hitherto unknown degree of purity. At the same time, the professor continues eagerly to pursue the various purely scientific inquiries with which he started.

R. DU BOIS-REYMOND.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Dr. Hann and the Fohn.

IN the good old meteorological times — before the advent of Dr. Hann and his fatal misapplication of the mechanical theory of heat to the phenomena of the atmosphere — it was generally considered that the hot winds of Switzerland, the so-called Föhn, had their birthplace in the Desert of Sahara. The good folks thought, in their simplicity, that the warm air which suddenly came upon them must have come from a hot place. They noticed that it always came from a more or less southerly direction, and judged that the sand-dust it carried with it must have come from some sandy region. They felt the sand-dust smart in their eyes, and saw how it discolored the snow white face of the mountains; but the sand-dust did not obstruct their vision further but they could judge that the dust must have got into the air from somewhere, and so they fixed upon the Sahara as the nearest and most likely locality.

It seems, indeed, marvellous that Dr. Hann's opposing theory could have made headway against such glaring and incontestible facts, as it should be much easier to convince the world of a simple and tangible truth than to convert it to the opposite theory, which has nothing whatever of observations of natural phenomena to support it; but when I here propose to maintain the old theory, by taking away the basis of Dr. Hann's, it may not seem unbecoming in me to say a few words in apology for such seemingly reckless behavior.

It is now nearly two years ago I published, through these columns, the rudiments of a theory of the atmosphere which is more or less diametrically opposite to the prevailing ideas on the subject. Rain was supposed to be due to expansion of moist air, and I found by experiments that it must be due to compression, etc. As far as I could ascertain, meteorologists had no objection to urge against my theory, but on further investigation it became clear to me that they possessed a high-priest, or *Dalai Lama*, in Dr. Hann, without whose sanction no new theory could be seriously considered by reputable meteorologists of any standing, and as he refrained from expressing himself directly on the subject, the matter was put aside for the time being. Dr. Hann, however, gave indirectly vent to his opinion; a few weeks after the publication of my theory Dr. Hann handed in to the Vienna Academy of Science a paper wherein he held forth that the established theories on the atmosphere required considerable modifications, and the modifications he proposed were all an approach towards the views which had immediately before been set forth by the present writer. This paper caused considerable discussion, but nobody seemed to consider the high-level observations on which he proposed to base these modifications of any real value. Any further approach to my views would undoubtedly have led Dr. Hann to upset his own theory of the Föhn, — a theory which has brought its author no inconsiderable renown during the past years, — and that any man should upset his own reputation as a philosopher could hardly be expected; and there is so far nothing to be said against his silence, as all is fair in war and love, and to gain time is the great object in all cases of emergency.

There is, however, a time for every thing, and as nearly two years have elapsed since I published what, in my humble opinion, is the true theory of the atmosphere, it may be about time for me, and my duty also, to endeavor to upset the chief obstacle against its adoption, which I consider Dr. Hann's Föhn theory to be.

I take occasion from an article by Mr. Rotch, on "Mountain Meteorology," in *American Meteorological Journal* (August, 1891), wherein this staunch upholder of Dr. Hann's views has very ably tried to systematize the aspects of the prevailing meteorological theories from this particular point of view. It is always a laudable endeavor, of any author, to try systematically to combine into a collected whole the varying theories concerning any particular branch of this science, as it enables the critic to mark out the weak point. The most consistent or systematic treatise on the atmosphere as a whole, which the present writer is acquainted with, is the "Elementary Meteorology," by Mr. R. H. Scott, and the remarkable candidness of its author made it a comparatively easy task for the present writer to point out, that, according to the causes of rain given there, we should not get any rain at all if we were to believe the gentlemen who had the atmosphere "in charge," so to speak. As I on that occasion dealt extensively with the question of the effect on the humidity of the air caused by ascent or descent of the air, I may at present confine myself to discuss exclusively the question of change in temperature caused by ascent or descent.

Mr. Rotch says, on page 154: "It has been shown by Dr. Hann that the Föhn owes its extreme warmth, as well as its dryness, to the descent from the ridges on the north side of the Alps, and that it does not bring it from further south. The warmth of the Föhn is explained by the fact that a mass of air sinking into one of higher pressure is warmed at a rate of one degree for each 300 feet of descent, and a rapidly sinking stream of air, which is so quickly heated, must be relatively very dry." And a few lines above we read: "The cool night wind (from the mountains) is caused by the sinking of the cold air into the bottom lands, and is most intense in narrow valleys, where there is great difference between the temperature of the valley and the plain," and again, during Föhn the temperature "rises sometimes 60° F. above the normal."

The unbiased reader cannot help noticing the anomaly that the mere descent of air is (1) in case of Föhn accused of causing a considerable rise in the temperature above the normal, and (2) in case of the night wind an equally considerable lowering of the temperature below the normal.

This contrast becomes even more drastic when Mr. Rotch says, page 151, "Slowly descending currents of cold air fill the valleys like rivers, while the summits receive the air warmed dynamically by descending from a greater height; and it seems obvious that the author has a little private theory of his own that it makes a great difference whether the air is descending slowly or not, whereby he tries to patch over the glaring discrepancy.

We may now set to work to put these contradictory theories to their proper test, thereby confining ourselves to statements contained in the article itself. It is thus truly mentioned that the air is warmed at the rate of 1° F. for each 300 feet of descent and cooled at the rate of 1° F. for each 300 feet of ascent, but we also find mentioned another fact, equally true, that, on an average, or under normal conditions, the temperature of the atmosphere decreases at the rate of 1° F. for each 300 feet rise; and this fact throws a peculiarly instructive light on the whole subject. It shows that under normal conditions air rising to any height will during the ascent be cooled by expansion at such a rate that wherever it goes it meets with air having a temperature exactly equal to its own, and also that air descending to any level will for a similar reason meet with air having a temperature exactly equal to its own, wherever it goes. In other words, for air arriving at any particular place to have an abnormally high or low temperature it must have had an equally abnormally high or low temperature at the locality where it started from.

Thus, in case of the Föhn wind, for this air to arrive in the valley at a temperature 60° F. above the temperature normally found there, it must have been heated 60° above the temperature normally found at the summit of the mountains from where it started, and it then remains with Dr. Hann to explain how this air acquired the abnormally high temperature before it commenced to descend, and until he has done this he can have no right to claim that he has added one particle towards the explanation of the phenomena of the Föhn; and, even if he was able to get over this difficulty, it still remains for him to explain the phenomenon of the sand-dust, before it can be recognized that the birthplace of the Föhn is anywhere but in the Desert of Sahara.

The phenomenon of cool night wind from the mountain and the accompanying higher temperature on the mountains than in the valleys find a ready explanation from the same premises. During clear nights the air nearest the earth's surface gets abnormally cooled through radiation, and the radiation is more intense on the mountains than on the plains. The cool contracted air will run off the slope of the mountain and accumulate in the valleys, while its place on the mountain-side is immediately taken up by air which has not as yet been cooled down by radiation. In the valleys the temperature gets lower than on the mountains, or the plains, because the cooling effect of radiation is there acting upon air which has previously been cooled considerably down by radiation on the mountain, and it is clear that the temperature must sink lower when radiation is acting upon air already cooled down, than when the temperature of the air was higher to start with.

The present writer has, on several occasions, tried to induce so able and prolific writer as Professor Hazen to attack his views for the sake of an argument, but the professor seems to decline to enter upon a discussion with any body who does not belong to the "meteorological camp," as he calls it. Now, be it said, in all kindness, that in our advanced age every body seems to be entitled to express his opinions on any scientific subject when he feels himself convinced of having found something new which may add to the progress of science, and also be entitled to a fair hearing; but be it said, as my impression when I accidentally arrived in the meteorological camp, all the inmates seemed to have decamped previously, leaving no one behind to shake hands with me; and this I thought a little discouraging. Dr. Hann may be a most excellent director of the Hohe Warte, and it may seem not a little reckless for an outsider to attack his theories; but it should be remembered that even a blind man may sometimes find a seed, — although a civil engineer of high training may not be entirely blindfolded, — and if there be any truth in the maxim of Dr. Hann's countryman, Feuerbach, "that no philosopher ever yet occupied a professorial chair in philosophy," so it might possibly be equally true that no philosopher in meteorology ever yet sat on Hohe Warte, however great his attainments as director or weather forecaster might have been.

FRANZ A. VELSCHOW, C.E.

Brooklyn, Nov. 9.

Auroral Phenomena.

AS Dr. Veeder has mentioned in his description of the aurora of Sept. 9, in *Science* for Nov. 6, some phenomena not ordinarily accompanying auroral displays that were also visible here, some notes made at the time may be of interest.

The aurora on that evening was unusually fine, probably the most brilliant observed in four years. It began about 7 40 P.M. as a faint arch five degrees above the northern horizon, which gradually became higher until a maximum height of eight degrees was reached at 8.15 P.M. Shortly before this time two smaller arches appeared beneath the principal arch, and soon afterward the ends of the three joined together, forming a serpentine band. This band at 8.20 P.M. broke up into brilliant streamers, which were constantly changing in appearance and length, alternately fading and becoming bright again.

This continued until 8.50 P.M , when the display reached its maximum brightness and the streamers their greatest length. The elevations of the ends of the streamers above the horizon were measured with a theodolite at times, the highest being at a height of 56°, though many exceeded 45°.

Between 9.15 and 9.30 P.M. the aurora diminished greatly in brightness, and at 9.25 two bands extended toward the zenith from the east and west respectively, joining together at 9.27, forming the narrow band that Dr. Veeder saw. This band was apparently of a uniform brightness, approximating that of the Milky Way, and continued, through the period of minimum brightness of the aurora, from 9.25 to 9.35 P.M. After 9.35 P.M. the aurora became brighter, and was visible at 11.40 P.M.

This band of light was seen at Nashua, N.H., and in this vicinity, while the aurora has been reported as visible at several places in Europe as well as America.

A similar band of light, extending through the zenith from opposite sides of the horizon, was observed during the aurora of May 20, 1888, which was described in *Science* by several observers during the succeeding month.

Five auroras were visible during September four of which occurred on the 7th, 8th, 9th, and 10th, respectively, — an unusually large number for such a short period of time.

S. P. FERGUSSON.

Blue Hill Observatory, Readville, Mass., Nov. 20.

AMONG THE PUBLISHERS.

D. C. HEATH & Co., Boston, will soon publish *Business Law*, prepared by Alonzo P. Weed. This is not only a text-book for business colleges and the business courses of schools and academies, but it is desirable for the desk of the business man.

— Charles F. Lummis, a Harvard man, who has lived for many years in New Mexico, begins in the Christmas *Scribner* a group of articles on that little-known territory, with its population of Pueblos, Mexicans, Navajos, and Americans. The articles will be illustrated from the author's own photographs, which are unusual in subject and variety.

— The October number of the "Papers of the American Historical Association" contains six articles. The first is a brief account of "Slavery in New York" under the colonial government. Then follow two papers on certain aspects of our national Constitution, the one on "Congressional Demands upon the Executive for Information" being the most suggestive. The next is "A Plea for Reform in the Study of English Municipal History," and there is also a longer article on the "Yazoo Land Companies," giving an account of a gigantic land speculation of a century ago, in which political intrigue played a prominent part. But the article that will be likely to interest the greatest number of readers is that on "The Lost Colony of Roanoke," by Stephen B. Weeks. The colony planted by Raleigh on Roanoke Island has always been supposed to have perished; but in 1885 Mr. Hamilton McMillan of North Carolina advanced the theory that the colonists retreated inland, where they ultimately intermarried with some friendly Indians, and that the Croatan Indians, now living in the western part of the State, are their descendants. The evidence for this theory in the physique, the traditions, and the names of those Indians is really quite striking; and persons interested in our early history will like to read Mr. Weeks's paper.

— A second edition of "Modern American Methods of Copper Smelting," by Dr. E. D. Peters, Jun., has just been published by the Scientific Publishing Company of this city. The book has met with great success, the demand for it having long since exhausted the first edition. The entire book has been practically rewritten, and new chapters have been introduced on the electrolytic assay of copper, the smelting of copper with gas in regenerative furnaces, and the smelting of copper-nickel ores in water-jackets. Additions of great importance have also been made to the chapter on reverberatory smelting, and this portion of the work has been illustrated by nine full sized pages, which form what is said to be the most complete set of detailed working drawings of the kind ever published. The arrangement of the book has been improved; and in addition to the full alphabetical index at the end, a detailed table of contents has been prepared that will be a great aid to the reader. The author has brought a riper ex-

perience to the preparation of this edition, having been actively engaged in the smelting of copper ores during the period that has elapsed since the first appearance of the book; and before preparing the new material he made a special trip through the West to note any improvements or modifications in the treatment of copper ores. The price of the book is $4.

— "Star Land," by Sir Robert Staurel Ball, F.R.S., Royal Astronomer of Ireland, published by Ginn & Co., is composed of talks with young people about the wonders of the heavens, told in a very interesting and attractive style. The well-known astronomical facts are placed before one, not in the usual cut and dried manner of the scientist and the mathematician, but well interspersed with anecdote and personal reminiscences that cannot fail to be pleasing and instructive to the amateur astronomer or to those wishing a short course in elementary astronomy.

— Ginn & Co. announce the first number of *School and College*, to be edited by Ray Greene Huling, and to appear in January, 1892. The contents will be: Some of the Next Steps Forward in Education, by E. Benjamin Andrews, president of Brown University; Secondary Education in Census Years, by James H. Blodgett, U. S. Census Office, Washington, D.C.; The Greek Method of Performing Arithmetical Operations, by John Tetlow, head-master Girls' High and Latin Schools, Boston; English in Secondary Schools, by Francis B. Gummere, professor of English in Haverford College; When Should the Study of Philosophy Begin? by B. C. Burt, formerly docent in history of philosophy at Clark University; News from Abroad; Home News; Letters to the Editor; and Reviews.

— P. Blakiston, Son, & Co., Philadelphia, will have ready Dec. 1 the new London edition of the late Dr. Carpenter's work, "The Microscope and its Revelations," edited by Professor Dallinger. This well-known book will appear in an almost entirely new form. The shape is different, owing to an enlargement of the page. Nineteen of the twenty-one full-page plates, some of which are colored, are absolutely new, and there are improvements in the woodcuts, of which there are to be 800, instead of 500, as in the previous edition. Special attention has been given to all that appertains to the practical construction and use of the instrument; but the interests of amateurs have not been neglected. The earlier chapters of the book have been entirely rewritten, and the work throughout has been brought up to date.

— *The Chautauquan* for December has several illustrated articles and portraits of a number of prominent men and women. The following titles are from the table of contents: "Domestic and Social Life of the Colonists," III., by Edward Everett Hale; "States made from Colonies," by Dr. James Albert Woodburn; "The Colonial Shire," by Albert Bushnell Hart, Ph.D.; "The History of Political Parties in America," III., by F. W. Hewes;

"Physical Life," III., by Milton J. Greenman, Ph.B.; "National Agencies for Scientific Research (The Weather Bureau)," by Major J. W. Powell; "The Parasitic Enemies of Cultivated Plants," by B. T. Galloway; "The Scottish Language," by Rev. William Wye Smith; "Modern Treatment for Insanity," by C. R. Hammerton; "Moral and Social Reforms in Congress," by George Harold Walker; "Fur-Seal and the Seal Islands," by Sheldon Jackson, D.D.; "A Trip up the Nile," by Armand de Potter; "The Homes of Poverty," by Emily Huntington Miller; "Prepared Food on a Scientific Plan," by Helen M. Ellis; "Women in Astronomy," by Esther Singleton; "Qualifications Requisite for the Trained Nurse," by Lisbeth D. Price; "The German Girl of the Middle Ages.

— Professor A. D. Morse is the author of a monograph recently published by the American Academy of Political and Social Science, on "The Place of Party in Political System." It is a treatise on the philosophy of party, a subject which has been generally neglected by political scientists. After showing by what other means the State has sought to hold the government in due subordination to itself, he proves that the institution of party is the best device for accomplishing this end. He shows how party carries out its two chief functions, namely, to educate and organize public opinion, and to administer government. In regard to this latter function, he holds that under a system of party government, the party in power does the work which falls to the king in a system which is really monarchical. The monograph will doubtless create considerable discussion, as we are not wont to put so high a theoretical value to the party system.

— D. C. Heath & Co. will publish shortly "Reading and Speaking: Familiar Talks to Young Men who would Speak well in Public," by Brainard Gardner Smith, associate professor of elocution and oratory, Cornell University. Especial importance is given to the theory of sentential delivery as based on the systems of Walker and Mandeville.